Intelligent Configuration of Social Support Networks around Depressed Persons

Aziz, A.A.; Klein, M.C.A.; Treur, J.

published in
Artificial Intelligence in Medicine - 13th Conference on Artificial Intelligence in Medicine, AIME 2011, Proceedings

2011

DOI (link to publisher)
10.1007/978-3-642-22218-4_4

document version
Publisher's PDF, also known as Version of record

Intelligent Configuration of Social Support Networks Around Depressed Persons

Azizi A. Aziz, Michel C.A. Klein, and Jan Treur

Agent Systems Research Group, Department of Artificial Intelligence
Vrije Universiteit Amsterdam, De Boelelaan 1081, 1081 HV Amsterdam, The Netherlands
{mraaziz,michel.klein,treur}@few.vu.nl

Abstract. Helping someone who is depressed can be very important to the depressed person. A number of supportive family members or friends can often make a big difference. This paper addresses how a social support network can be formed, taking the needs of the support recipient and the possibilities of the potential support providers into account. To do so, dynamic models about the preferences and needs of both support providers and support recipients are exploited. The outcome of this is used as input for a configuration process of a support network. In a case study, it is show how such an intelligently formed network results in a reduced long term stress level.

Keywords: Agent-Based Modeling, Configuration, Cognitive Models, Social Support Networks, Unipolar Depression.

1 Introduction

Stress is an ever present aspect of life. Long term exposure to stress, often leads to depression [7]. A depression is a mood disorder characterized by a depressed mood, a lack of interest in activities normally enjoyed, fatigue, feelings of worthlessness and guilt, difficulty concentrating and thoughts of death and suicide [4]. If a person experiences the majority of these symptoms for longer than a two-week period they may be diagnosed with major depressive disorder. There has been much recent emphasis on the role of social support network to overcome stress [1, 4]. Social support network refers to the provision of psychological and material resources from the social network, intended to enhance an individual's ability to cope with stress [1]. Essentially, it involves interpersonal transactions or exchanges of resources between at least two persons intended to improve the well-being of the support recipient. From this view, it can promote health through a stress buffering process, by eliminating or reducing effects from stressors.

In this paper it is addressed how a social support network can be formed, taking the needs of the support recipient and the possibilities of the potential support providers into account. This approach can provide a basis for an intelligent application that dynamically suggests support networks based on information available in social network software. The contribution of this paper is twofold. First, an extension of an existing model on preferences for types of social support from the perspective of the recipient (the patient) is presented. The extension describes the process of responding to a request of a specific type from the perspective of the support provider: the social

M. Peleg, N. Lavrač, and C. Combi (Eds.): AIME 2011, LNAI 6747, pp. 24–34, 2011.

network member that might provide support (Section 2). Second, an approach to use this extended model is proposed for the automated selection of a subset of the patient's social network members that together will provide optimal support (Section 3). In Sections 4 and 5 a fictitious case study is described that illustrates this process. Finally, Section 6 concludes the paper.

2 Dynamic Model of Support Receipt and Provision Process

In this section the support provision and receiving process will be discussed, and a computational model for these processes is presented.

2.1 Important Concepts in Support Receipt and Provision

Before the introduction of the formal model, first the factors will be discussed of the process of giving and receiving support that are important according to the literature. Published studies on this process have usually focused on the perspective of the recipient, provider, and relationship [5]. One of the salient factors to ensure support can be provided is the request for support. Requests for support may be expressed either *directly* or *indirectly*. Direct request strategies differ from indirect strategies primarily with regard to two inextricably fused aspects; namely, their communicative clearness and their demand characteristics [10]. In this case, personality plays a central role to determine either direct or indirect request is expressed, for example; individuals' with neuroticism to express their request emotional support request through unpleasant emotions gestures. Another important component related to the support recipient factors is the requested support (*need of support*). Support recipients must recognize the need for support and be willing to accept assistance. This factor is influenced by peoples' perceptions of their expectations of others (*perceived the availability of support*) [14].

Types of support needed are highly related with recipients' social tie preference. For example, one reason why individuals may opt for a weak tie support members (e.g: colleague) is that weak ties often provide access to diverse points of information (*informational support*) [10]. In additional to this, researchers have found that health concerns are often difficult topics for people to discuss, especially with interacting with the close tie members. However, other types of support such as *instrumental, emotional* and *companionship* are highly related to the strong tie (close friends, family) preference [6]. Another important factor to allow social support is the provider's willingness to help. If the willingness is high, then one is more likely to provide support and vice versa [6, 11]. Provider's willingness is related to the personality attributes and *altruistic* behaviour. The *agreeableness* and highly altruistic individuals contribute to a higher willingness level to help compare those who are not.

2.2 Formal Specifications of Support Recipient and Provision Process

The characteristics of the proposed (extension of the) model are heavily inspired by the research discussed in the previous section on support receipt and provision process. In Figure 1, the states that are depicted in grey represent states that have been modeled in the previous work. The same holds for the dashed lines. Readers

interested in these relationships are directed to [2, 3]. In the formalization, all nodes are designed in a way to have values ranging from 0 (low) to 1 (high). To represent these relationships in agent terms, each variable will be coupled with an agent's name (*a* or *b*) and a time variable *t*. When using the agent variable *a*, this refers to the agent's support receipt, and *b* to the agent's support provision.

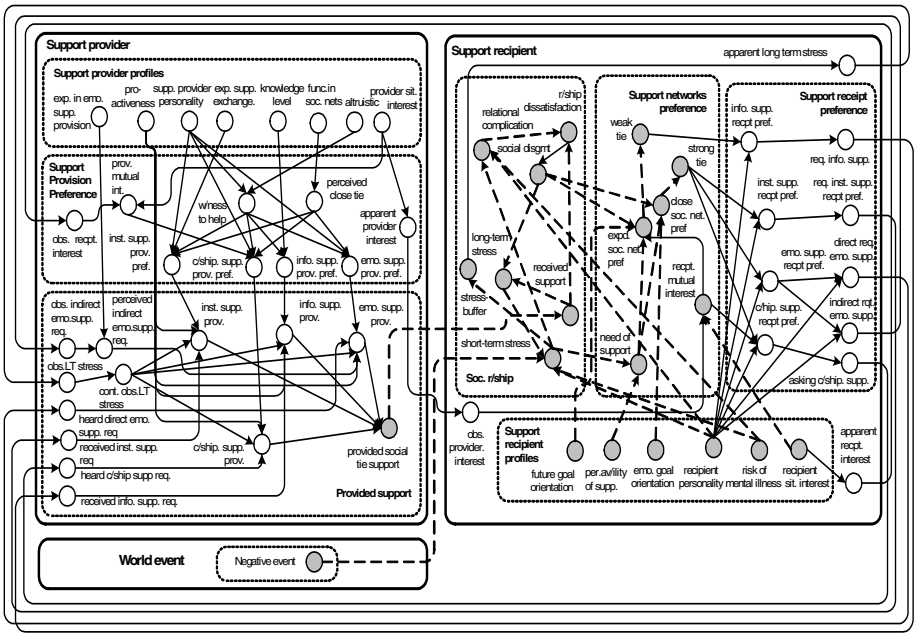

Fig. 1. Global Relationships of Variables Involved in the Support Receipt and Provision Process

Long Term Stress, and Social Disengagement: In the model, the world events are generated by simulating potential effects throughout *t* time. Short-term stress (*StS*) refers to the combination of negative events, risk in mental illness (vulnerability), and neurotic personality. Related to this, accumulation series of *StS* will develop the long term stress (*LtS*). Relational dissatisfaction (*RdS*) is determined by relational complication when no support is given. Social disengagement (*SdG*) is primarily contributed the accumulation exposure towards relational dissatisfaction.

$$LtS_a(t+\Delta t) = LtS_a(t) + \eta_L.[Pos(StS_a(t) - LtS_a(t)).(1 - LtS_a(t)) - Pos(-(StS_a(t) - LtS_a(t)).StS_a(t))].\Delta t \quad (1)$$

$$SdG_a(t+\Delta t) = SdG_a(t) + \psi_s.(1-SdG_a(t).[(RdS_a(t)-SdG_a(t))].SdG_a(t).\Delta t \quad (2)$$

Need of Support, Recipient Mutual Interest: Combination of short term stress (*StS*) and perceived the availability of support (*PvS*) triggers the need of support. Recipient mutual interest (*RmT*) is determined by number of similar interest between provider (*OpI*) and recipient (*RsI)* interest related to *n* activities.

$$NoS_a(t) = StS_a(t).PvS_a(t) \quad (3)$$

$$RmT_a(t) = \sum sim(RsI_a(t), OpI_a(t))/ n \quad (4)$$

Support Preference (Informational, Instrumental, Emotional, Companionship): Informational support preference (*FrP*) is expressed by combining weak tie preference (*WsP*) and conscientiousness personality (*RcS*). While, combination of strong tie preference (*SsP*) with extraversion (*ReV*) generates instrumental support preference (*NrP*), and neurotic personality generates emotional support preference (*ErP*). The value of companionship support preference (*CrP*) depends by strong tie preference in combination of with the risk in mental illness (*RmI*), and extraversion personality.

$$FrP_a(t) = WsP_a(t).RcS_a(t) \quad (5)$$
$$NrP_a(t) = SsP_a(t).ReV_a(t) \quad (6)$$
$$ErP_a(t) = SsP_a(t).RnU_a(t) \quad (7)$$
$$CrP_a(t) = [\psi_c.RmI_a(t) + (1-\psi_c).ReV_a(t)].SsP_a \quad (8)$$

Provider Mutual Interest, Willingness to Help: Provider mutual interest (*PmT*) is calculated using a similar concept as in recipient mutual interest. Willingness to help (*WsH*) is modelled by instantaneous relations of agreeableness (*PaG*) and altruistic (*AiC*) personality.

$$PmT_b(t) = \sum sim(OrI_b(t), PsI_b(t))/n \quad (9)$$
$$WsH_b(t) = \Omega_w.PaG_b(t) + (1-\Omega_b).AiC_b(t) \quad (10)$$

Support Provision Preference (Informational, Instrumental, Emotional, Companionship): All support provision preferences require willingness to help (*WsH*) in the model, and with its additional attributes. For example, informational provision preference (*FsF*) needs a knowledge level about the problem (*KwL*). While, instrumental provision (*IsF*) is calculated using the combination of agreeableness (*PaG*), perceived close tie (*PcT*), and experience in supportive exchange (*EsE*). Emotional support provision (*EsF*) depends on perceived close tie, and agreeableness. Finally, companionship support provision (*CsF*) requires provider mutual interest, perceived close tie, and extraversion personality (*PeV*).

$$FsF_b(t) = \tau_f.WsH_b(t) + (1-\tau_f).KwL_b(t) \quad (11)$$
$$IsF_b(t) = [\varphi_f.PaG_b(t) + (1-\varphi_f).EsE_b(t)].WsH_b(t).PcT_b(t) \quad (12)$$
$$EsF_b(t) = [\lambda_e.PcT_b(t) + (1-\lambda_e).PaG_b(t)].WsH_b(t) \quad (13)$$
$$CsF_b(t) = [\gamma_c.PmT_b(t) + (1-\gamma_c).PcT_b(t)].PeV_b(t).WsH_b(t) \quad (14)$$

Provided Support: In general, specific supports (informational (*IfP*), emotional (*EsP*), instrumental (*InP*), and (*CsP*)) can be measured by combining some proportion of proactive effort (*PaC*), and an active observation of long term stress (*AoS*) with particular support preference attributes and support requests (informational (*RfR*),direct emotional (*DeR*), indirect emotional (*PiE*), instrumental (*RnR*), and companionship (*HcR*) support requests). These support requests are combined to model accumulated suppot (*ApS*), and later, provided support (*PsS*).

$$IfP_b(t) = PaC_b(t).AoS_b(t) + (1-PaC_b(t)).FsF_b(t).RfR_b(t) \quad (15)$$
$$EsP_b(t) = PaC_b(t).AoS_b(t) + (1-PaC_b(t)).\ [\rho_e.DeR_b(t) + (1-\rho_e).PiE_b(t)].EsF_b(t) \quad (16)$$
$$InP_b(t) = PaC_b(t).AoS_b(t) + (1-PaC_b(t)).IsF_b(t).RnR_b(t) \quad (17)$$
$$CsP_b(t) = PaC_b(t).AoS_b(t) + (1-PaC_b(t)).HcR_b(t).EsF_b(t) \quad (18)$$
$$AoS_b(t+\Delta t) = AoS_b(t) + \lambda_a.[Pos(AlS_b(t)- AoS_b(t)).(1-AoS_b(t))- (- Pos(AlS_b(t) - AoS_b(t))).AoS_b(t)].\Delta t \quad (19)$$

$$PsS_b(t+\Delta t) = PsS_b(t) + \beta_p.[Pos(f(ApS_b(t))- PsS_b(t)).(1-PsS_b(t))- (-Pos(f(ApS_b(t))- PsS_b(t))).PsS_b(t)].\Delta t$$
where, $f(ApS_b(t))$ is a logistic unit function, $2.(1/(1+\eta.e^{-\alpha(ApS_b(t))})-0.5)$, and
$ApS_b(t) = IfP_b(t)+ EsP_b(t)+ InP_b(t)+ CsP_b(t)$ (20)

The operator Pos for the positive part is defined by $Pos(x) = (x + |x|)/2$, or, alternatively; $Pos(x) = x$ if $x \geq 0$ and 0 else. For the similarity function, $sim(.)$ is defined by $sim(x,y) = 1$ if $x=y$ or otherwise 0.

3 Configuring Social Support Networks

In order to achieve an intelligent assignment of people to a social support network, an approach has been followed in which the dynamic domain model for support receipt-provision process is used as basis for a configuration process. The description of how a domain model can be used to support a person is sometimes called a *support model*. Based on the required support, this support model selects people from an individual's social network and assigns them to the social support network.

3.1 Concepts in the Configuration Approach

Configuration is an application area in Artificial Intelligence that deals with the formation of complex solutions from a set of simpler components. It has been developed in a number of domains, such as manufacturing, medical therapy, industrial plans, personalized marketing ordering, and electronics design [8, 13, 15]. Technically, configuration is the process of creating a technical system from a predefined set of potential objects / components. It begins with broad specifications, and end with in depth specifications of what components are needed and how they are to be arranged [13]. The outcome of such a process has to fulfil a set of given constraints and requirements. Requirements differ from constraints in that constraints must not be violated (*logical consistency*), while requirements must be fulfilled (*logical consequence*) [15]. The configuration itself is performed in an incremental approach, where each step represents a configuration result and possibly includes testing, or simulating with constraint techniques. In general, there are two types of configuration methods namely; 1) *representation-oriented*, and 2) *task-oriented* [15]. The main objective of representation-oriented view is to find the right representation for expressing the structure of the problem domain, while in task-oriented, it focuses to identify the sub-problems to be solved [8]. Several configuration methods such rule-based configuration, dynamic constraint satisfaction problem, and resource-based configuration fall under the group of representation oriented methods. Meanwhile, case based reasoning and hierarchical method can be grouped under task-oriented methods. A detailed discussion on these methods is beyond the scope of this article. Readers interested in those methods will find [13, 15] useful.

3.2 Interaction between Domain and Support Model

There are two fundamental steps in the design of a support model for support provision task assignment. The first is that information about human's states and

profiles is fed into a dynamic model of social receipt and provision, which will result in requirements and constraints about the support network. In the second step this will be used to select social support members within the observed social networks. More importantly, this support model will assign support provision task among selected members in line with their resources and preferences. Figure 2 depicts interactions between support model and dynamics model.

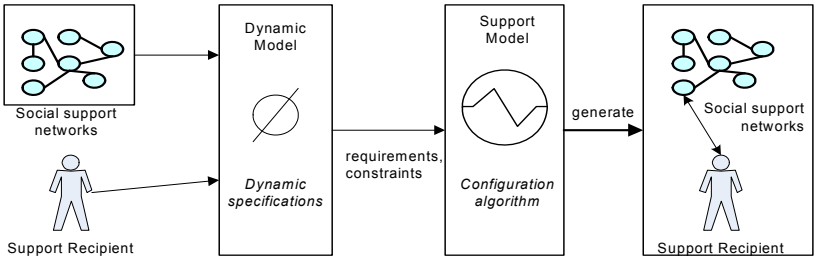

Fig. 2. Interaction between support and dynamic models

As can be seen in Figure 2, important information of all members in social networks and a potential support recipient will be fed into the dynamic model. Within the dynamic model, instantaneous and temporal relationships will compute both support receipt and provision preferences. Moreover, within the dynamic model, information about support recipient's well-being, such as long-term stress can be monitored. This is crucial as it is a vital indicator when to activate the support model.

In this paper, a resource-based configuration approach is used. This approach assumes that all individual components can be viewed as providing a resource needed in the system. The aim of the configuration model is to select the correct set of support providers based on their ability and the type of support they can provide. The structure of relationships between requested and provided support are not expressed in terms of individual or one-to-one matching, but in terms of their preferences. Therefore, it is possible to describe members providing multiple types of supports and utilizing these preferences. For example, a requirement for a support of 0.3 (on the scale between 0 and 1) can be satisfied by using three support providers with 0.1 amount each.

3.3 A Configuration Algorithm to Assign Support Members

In this paper, the configuration process utilizes support recipient information (from the agent's model) to select support members that available for support provision. The crucial information (*requirements*) needed for a configure process are; 1) tie's preferences, 2) long-term stress, 3) support receipt preferences, 4) function in social networks, and 5) support provision preferences. Using this information with a set of configuration rules, an algorithm to generate a set of social support members to provide support is developed (see Algorithm 1 for details). At the start of this algorithm, a set of constraints, like preference number of providers, percentage of assigned supports, and a level of acceptance burden must be initialized first.

Algorithm 1. Steps in the Configuration Process

Input: task assignment, number of support provider, acceptable support provider's burden level, and configuration requirements.
Output: A set of selected support providers
Process: Repeat steps S1-S10 until one of the stopping criteria is satisfied.
S1: Check support receipt long term stress and need of help to start the process.
S2: Input task assignment, number of support provider, and acceptable burden level. Stop if no more task assignment or number of support provider can be assigned
S3: Determine the support network preferences,
weak_ tie_ preference (%) = (WsP / (WsP + SsP)).100.
strong_ tie_ preference (%) = (SsP / (WsP + SsP)).100.
S4: Evaluate support receipt preference (requested support)**.**
S5: Assign support provision according to required preferences and tasks equally. Member with a high support provision will be chosen first, and so forth. If the task assigned or tie preference > the number of support provider, repeat S2.
S6: Assign support providers corresponding to their support provision preferences.
S7: Always assign emotional and companionship support to members in close tie networks if such support resources are still available. Otherwise assign it to another member within weak tie group.
S8: Compute the ratio of provided support over requested support.
*overall_provided_support(%)=Σ(provided_support)/Σ(requested_*support).*100*
S9: Evaluate support provider burden. If it exceeds the acceptable burden, repeat S2.
burden_provider (%) = Σ(provided_support)/Σ(support_preference).100
S10: Evaluate assigned support. If assigned support ≥ requested support then construct the list contains the assigned members to provide support, else repeat S2.

Information such as a function in social networks can be used to choose the right support provider. If any individual experiences a heighten long term stress level but do not have any support network preferences, then the agent will have its own autonomy to select suitable individuals for support provision purposes. The expected result from this algorithm is the assignment of social provision tasks for support members in social support networks. Figure 3 summarizes the outcome of this process.

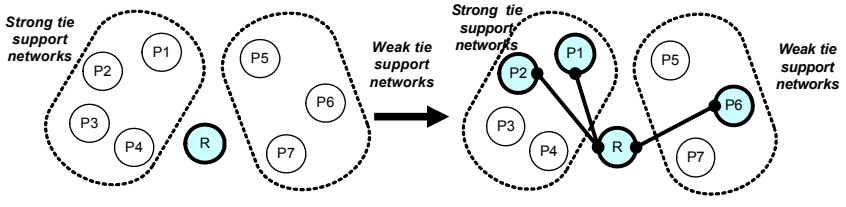

Fig. 3. Social Support Assignment within Social Support Networks

From Figure 3, consider this example; *R* requires social support from his/her support networks (*P1, P2,..., P6*). To assign support provision task, the support model will extract important information from the domain model, and perform a configuration process. Based on several pre-determined requirements and constraints, the support model will generate a list contains potential members to provide support. Potential support providers will be selected either from a strong tie network, or a weak tie

network, or both networks (in above example, it was from both networks, *P1* and *P2* from the strong tie support networks, and *P6* from the weak tie support networks).

4 Case Study

In this section, a simple case study to show the results of support model is presented. The proposed model has been implemented in visual programming platform by constructing several scenarios to generate simulation traces. For the sake of brevity, only two types of support request and provision will be discussed.

4.1 Support Assignment

In this case study, eleven different fictional persons are studied under several parameters and attributes for social support receipt and provision. Consider this example: *"Piet experiences stress and seeks for help. From his personality and preferences, he needs more informational support (0.7) than companionship support (0.3). What is more, he prefers members from a weak tie network (0.7) to a strong tie network (0.2). Within his social support networks, he has four members in a strong tie and six members in a weak tie network."* From these members, the support provision availability is the following (*tie network, informational support, companionship support*); **Kees** (*strong, 0.3,0.4*), **Peter** (*strong, 0.1,0.5*), **Anke** (*strong, 0.5,0.5*), **Frieda** (*strong, 0.2, 0.4*), **Jasper** (*weak, 0.5,0.1*), **Bert** (*weak, 0.3, 0.2*), **Johan** (*weak, 0.2, 0.1*), **Sara** (*weak, 0.6,0.2*), **Vincent** (*weak, 0.1, 0.2*), and **Kim** (*weak, 0.2, 0.1*). In this case, three individuals were assigned to provide help. Note that this information is generated from the dynamic model of support receipt and provision process.

Using a support tie preference, he prefers 78 % from support members in a weak tie (≈ 2 members), and 22 % from a strong tie (≈ 1 member). Furthermore, 50 % of provision tasks have been assigned to both members in a weak tie and 100 % for a member in a strong tie. As for the accepted burden level, each individual should not exceed more than 60 % of his/her ability. Based on available information, the algorithm generates this result (see Table 1).

Table 1. Selected Support Provision Members

Name (strong tie)	Info.	C/ship	Name (weak tie)	Info.	C/ship
Kees	-	-	Jasper	0.25	-
Peter	-	-	Bert	-	-
Anke	0.15	0.3	Vincent	-	-
Frieda	-	-	Sara	0.30	-
			Johan	-	-
			Kim	-	-
Provided support *(%)*	**21 %**	**100 %**		**79 %**	

From this, support burden is calculated; where Anke will contribute 45 % of her total ability to support, follow by Jasper (42 %), and Sara (38%). If any of these figures exceed the accepted burden level, a new support distribution will be asked. If necessary, the algorithm will select another member to provide support. In this case,

Anke will provide 30 % of her preference in informational support, and 60 % in companionship support. Both Jasper and Sara will provide 50 % of their ability to provide informational support to Piet.

4.1 Simulation Results

To analyse the configuration results from our case study, the model presented in Section 2 is used to determine the effect of different variants of support networks. Three conditions have been simulated; namely 1) no support is assigned, 2) random support assignment, and 3) configured support assignment. In the first condition, no support is assigned to help support recipient. As for the second condition, three support members were selected randomly (random numbers were generated to select support members). For the last condition, support members were selected from the list generated by a proposed configuration algorithm. During this simulation, a person (support recipient) has been exposed to an extreme of stressors, to represent the prolonged stressors throughout a life time. The outcomes from these conditions are measured using the individual's long-term stress, and social disengagement levels. These results show selection the right support members have a substantial impact on the course of the long-term stress on support recipient.

For simplicity, the current simulations used the following parameters settings: t_{max}=1000 (to represent a monitoring activity up to 42 days), Δt=0.3, flexibility rates = 0.3, and regulatory rates = 0.5. These settings were obtained from previous systematic experiments to determine the most suitable parameters values in the model. For all cases, if the long term stress is equal or greater than 0.5, it describes the support recipient is experiencing stress condition. These experimental results will be discussed in detail below.

Results #1: No Support Provided. During this simulation, a person receives no support from its social network. The person experiences very negative events throughout the simulation time. Since the person needs help, but no support has been provided, then a person is unable with the incoming stressors. This results in an increase of the long-term stress. In case the person is more vulnerably towards stress, the long-term stress increases more quickly and therefore it takes more time for the person to recover. For this case, Figure 4(a) shows the effect on social disengagement where it represents a potential risk to isolate from any social interactions. This condition is one of the precursors to develop a depression if no support is given in future [11]. Similar findings can be found in [9, 10].

Results #2: Random Support Assignment. The analysis of random support assignment helps to understand the effect of support provision assignment without a proper strategy. Figure 4 (b) depicts the effect from this support. As it can be seen in Figure 5, this result provides evidence that by randomly selecting support members is not the best choice if there are many possible variants in support requests and provider's preferences. Although, apparently the long-term stress is decreasing slightly, is not enough to guarantee a person to recover from the incoming stressors. In addition to this, there is a possibility to have a support provider with no support provision preference that matches with the support needed. Thus, a person will have least a chance to recover. On the other hand, if a support provider with the right support

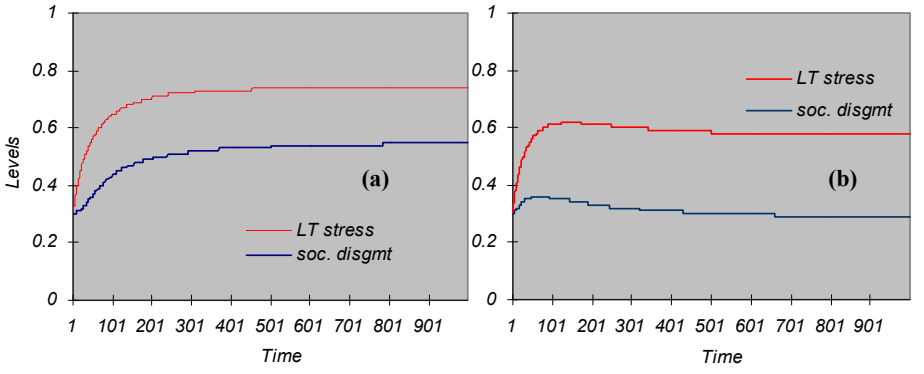

Fig. 4. Person with (a) No Support and (b) Random Support Provision

preference was chosen, there is a risk that it might burden the provider [5, 7]. Having this in motion will hamper the effectiveness of support receipt and provision process.

Results #3: Configured Support Assignment. In this scenario, a person receives support from suggested support members by the configuration approach. Figure 5 shows a more consistent and gradual decrease in a long-term stress level, compared to the random support assignment. For this scenario, it can be seen that the social disengagement is decreasing, and potentially to show that a person is accepting social support and improving the social interaction within a social support network. This condition occurs almost within the majority of individuals when they received the right support by their support members [4, 10, 11].

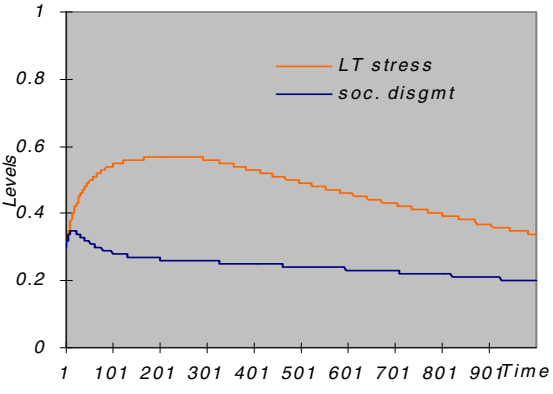

Fig. 5. Person with Configured Support Provision

5 Conclusion

The case study illustrates that the dynamic model about support provision and receipt together with a configuration algorithm can be used to intelligently form a social support network around persons experiencing stress. The simulations suggest that such an assignment results in a lower long term stress level and a reduced level of social disengagement. Ultimately, this might help people in preventing depression or recovering from a depression. Social networks have always been important in stress reduction, but since social network software (e.g. Facebook, MySpace) has become enormously popular in recent times, it starts to become realistic to think about

automating support network formation. Much information about social relations and personal characteristics are available nowadays. For the application of the dynamic models used in this paper, more specific information is needed than what is usually shared via social media. However, it is not unrealistic to envision applications that ask people for such information for specifically this goal of support provision. In future research, it should be investigated which information is essential for an effective formation of a social support network and whether people are able and willing to provide that information.

References

1. Adelman, M.B., Parks, M.R., Albrecht, T.L.: Beyond close relationships: support in weak ties. In: Albrecht, T.L., Adelman, M.B. (eds.) Communicating Social Support, pp. 126–147 (1987)
2. Aziz, A., Treur, J.: Modelling Dynamics of Social Support Networks for Mutual Support in Coping with Stress. In: Nguyen, N.T., Katarzyniak, R.P., Janiak, A. (eds.) New Challenges in Computational Collective Intelligence. SCI, vol. 244, pp. 167–179. Springer, Heidelberg (2009)
3. Aziz, A.A., Klein, M.C.A., Treur, J.: An Agent Model for a Human's Social Support Network Tie Preference during Unipolar Depression. In: Proceedings of the 9th International Conference on Intelligent Agent Technology (IAT 2009), pp. 301–306. IEEE Computer Society Press, Los Alamitos (2009)
4. Bolger, N., Zuckerman, A., Kessler, R.C.: Invisible support and adjustment to stress. Journal of Personality and Social Psychology 79(6), 953–961 (2000)
5. Burleson, B.R.: Emotional Support Skills. In: Handbook of Communication and Social Interaction Skills, pp. 551–594 (2003)
6. Cohen, S.: Social Relationships and Health. American Psychologist 59, 676–684 (2004)
7. Etzion, D.: Moderating Effect of Social Support on the Stress-Burnout Relationship. Journal of Applied Psychology 69, 615–622 (1984)
8. Fohn, S.M., Liau, J.S., Greef, A.R., Young, R.E., O'Grady, P.J.: Configuring Computer Systems through Constraint-Based Modelling and Interactive Constraint Satisfaction. Computer in Industry 27, 3–21 (1995)
9. Goldsmith, D.J.: Communicating Social Support, pp. 25–33. Cambridge University Press, Cambridge (2004)
10. Haines, V.A., Hurlbert, J.S., Beggs, J.J.: Exploring the Determinants of Support Provision: Provider Characteristics, Personal Networks, Community Contexts, and Support Following Life Events. J. Health and Social Behaviour 37, 252–264 (1996)
11. Helgeson, V.S.: Social Support and Quality of Life. Supplement: Multidisciplinary Perspectives on Health-Related Quality of Life, vol. 12, pp. 25–31 (2003)
12. Stice, E., Ragan, E.J., Randall, P.: Prospective Relations between Social Support and Depression: Differential Direction of Effects for Parent and Peer Support? Journal of Abnormal Psychology 113(1), 155–159 (2004)
13. Stumptner, M.: An Overview of Knowledge-Based Configuration. AI Communications 10, 111–125 (1997)
14. Tausig, M., Michello, J.: Seeking Social Support. Basic and Applied Social Psychology 9(1), 1–12 (1988)
15. Yang, D., Dong, M., Miao, R.: Development of a Product Configuration System with an Ontology-based Approach. J. Computer-Aided Design 40, 863–878 (2008)